EVALUATION OF REPERTORY GRID CONSTRUCT SUPERORDINACY USING CLUSTER ANALYSIS AND PRINCIPAL COMPONENTS ANALYSIS

By

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Using Kelly's theory of personal constructs, this study evaluated measures of superordinacy for individual constructs in terms of their relationship to element consistency and construct stability, properties theorized by Kelly to characterize superordinate constructs. The methods of assessing superordinacy differ in their criteria, each based on different aspects of Kelly's theory of construct system organization. The functional similarity measure is based on the assumption that superordinate constructs will be the most intercorrelated of a group of similar constructs, and the bridging superordinacy measure is based on the assumption that superordinate constructs will link disparate clusters of subordinate constructs and are identifiable by their

ability to connect these clusters. It was predicted that both measures would identify constructs that were more consistent over time, as measured by construct stability and element consistency, and that bridging constructs would have a higher degree of relationship to these measures than constructs meeting the functional similarity criterion.

Repertory grids were administered to subjects twice over a one month interval. The superordinacy measures were derived from the first grid using cluster and factor analytic techniques to determine the pattern of construct relationships, and individual constructs were identified as superordinate by the different criteria for each superordinacy measure. Element consistency and construct stability were measured by assessing differences in construct usage between the two grids.

Results of linear regression analyses indicated that the functional similarity measure had the predicted relationship to element consistency and construct stability, but that the bridging measure did not. These results suggest either that the bridging properties of superordinate constructs are less important than functional similarity to other constructs, or that they are less salient in grids of the type used in this study. The implications of these findings were discussed in terms of Kelly's theory and in relation to measurement issues.

CHAPTER 1
INTRODUCTION

A repertory grid is best defined as "a set of representations of the relationship between the set of things a person construes (the elements) and the set of ways that person construes them (the constructs)" (Bell, 1988, p. 101). Repertory grid technique has played a crucial role in the development of George Kelly's personal construct theory, beginning with Kelly's (1955) original work and proceeding through later changes and refinements (Bannister and Mair, 1968; Fransella and Bannister, 1977; Bell, 1990). Strictly speaking, the repertory grid is not a psychometric instrument, but a method of gathering data from which measures can be derived. According to Bonarius (1965),

> One may even doubt whether Kelly did well by naming this repertory technique a "test", thus suggesting a relationship with those instruments used to assess well-defined personality variables, such as intelligence. A more appropriate name might have been Rep Design. (p. 103)

Efforts to evaluate grid measures in terms of such traditional psychometric properties as reliability and

validity run counter to Kelly's view of both the person and the underlying construct system being measured as a fluid, constantly evolving structure. For Kelly's purposes, "The person is not an object which is temporarily in motion but is himself a form of motion" (Kelly, 1955, p. 78). The dilemma of trying to remain true to this concept while simultaneously using grids in ways comparable to traditional psychometric instruments is one reason for the current proliferation of divergent views of grid methodology.

The major problem with developing overall measures of construct-system characteristics is that the traditional psychometric approach to such measures assumes that they quantify some stable, intrinsic property of the construct system that will be reproducible by readministering the instrument at a later time. Kelly allows for no such invariant attributes in his theory. He considered the change in the construct system as another property of the system, rather than a flaw in the method of measuring it. Kelly also predicted that the repertory grid would capture the variety and complexity of the person's construct system and thus represent the multidimensionality of the construct system. This is contrary to the traditional psychometric approach of developing a technique for measuring one

property and excluding items that measure other properties and thus introduce extraneous variance. Indeed, Bell and Keen (1981) have suggested that traditional measures of internal consistency, such as Cronbach's alpha, may be demonstrated to have acceptable levels in repertory grids only in the absence of such theoretically meaningful grid properties as cognitive complexity. They have even posited that low internal consistency is a good measure of cognitive complexity. Kelly's theory predicted that the repertory grid would have poor psychometric properties if it accurately captured the diversity and fluidity of the person's construct system.

The alternative to internal consistency in a psychometric instrument is test-retest reliability, and here again personal construct theory and traditional test development are at cross purposes. Despite Kelly's emphasis on change as a property at least as important as stability of the grid, most work in this area has followed the typical psychometric approach of developing grid measures in a way that maximizes reliability and either ignores construct-system changes or treats them as error variance. According to Fransella and Bannister (1977), the goal is not to produce stable measures of an unstable phenomenon but to remain true to the properties

of the construct system being measured and to assess predictable stability and predictable change.

Several authors' overviews of the development of grid methodology (Fransella and Bannister, 1977; Adams-Webber, 1979; Neimeyer, 1985) have pointed out that the analyses developed to derive structural measures from repertory grids have acquired a life of their own far removed from Kelly's theory. This proliferation of "grids for grid's sake" analysis has obscured the theoretical basis and relevance of the measures derived from these grids. Some areas of the theory, particularly those dealing with overall integration or differentiation of construct systems and superordinancy of individual constructs, have several dissimilar measures purporting to quantify the theoretical construct in question (Bannister and Salmon, 1967; Klion, 1987). Other areas, notably assessing the pattern of change in construct systems as they evolve, have been neglected by developers of structural measures, even though they play a central role in Kelly's original writings. As Bell (1988) has noted, the preponderance of repertory grid analyses has capitalized on correlational relationships among constructs in a manner that obscures the dynamic nature of these relationships and confounds causal and other directional links between individual constructs.

To understand this concept of dynamic change within parameters dictated by the nature of constructs, one must consider two of Kelly's corollaries, the organization corollary and the modulation corollary. Kelly assumes that systematic changes in conceptual structures involve an organizing principle--constructs do not change their relationships among themselves indiscriminantly but along lines dictated by "permeable superordinate constructs" (Kelly, 1955, p. 58). Rearrangements in the relationships among constructs are systematic in that subordinate constructs are relatively free to vary, but they maintain their relationships to higher-order, more invariant constructs throughout the change process. The relationships among these superordinate constructs are maintained despite the new configurations established by the subordinate constructs.

Kelly's fragmentation corollary allows for the differentiation of an individual's construct system into independently organized subsystems of implicatively linked constructs. However, the extent of this differentiation is determined by the presence of superordinate constructs sufficiently permeable to apply to the subordinate constructs in both their old and new configurations; otherwise, the construct system would not be able to evolve from its old to its new organization.

The more differentiated the current structure of the system in terms of independently organized subsystems, the greater the chance that a person would be able to assimilate an unfamiliar experience into a pre-existing subsystem, because there are a greater number and variety of such subsystems. Alternatively, the presence of unassimilatable events that fit no pre-existing system or subsystem may require the development of new and independent substructure in order to accommodate it adequately. Again, this would involve further differentiation of the system and require re-integration of both old and new substructures along the dimensions of superordinate constructs.

Thus, to Kelly, a construct system is hierarchically organized with subsystems of interrelated constructs, with these subsystems connected by superordinate constructs.

> Within a construct system there may be many levels of ordinal relationships with some constructs subsuming others and those in turn subsuming still others. When one construct subsumes another its ordinal relationship may be termed superordinal and the ordinal relationship of the other becomes subordinal. . . . Thus man systematizes his constructs by concretely arranging them in hierarchies and by abstracting them further. But whether he pyramids his ideas or penetrates them with insights, he builds a system embracing ordinal relationships between constructs for his personal convenience in anticipating events. (Kelly, 1955, pp. 57-58)

There are two basic types of measures to detect and quantify this hierarchical organization of construct systems. The first kind quantifies the multidimensionality of construct systems and infers hierarchical linkage from the similarities in usage among constructs, and the second type traces the implicative linkages among constructs directly by asking the subject how changes in one construct affect others. Examples of the former technique are principal components analysis of repertory grids (Slater, 1964, 1977; Ryle, 1975), nonparametric variants such as cluster analysis (Rathod, 1981; Leach, 1981) and Landfield's (1971, 1976) functionally independent construction (FIC) measure. This type of measure will be referred to as the direct-measure technique. The exploration of implicative linkages by asking the subjects how changes in one construct affect other constructs, or self-report technique, was originated by Hinkle (1965) and elaborated upon by others (Fransella, 1972; Gaines and Shaw, 1980). These researchers have expanded the traditional grid into a form called an implications grid, or impgrid, which delineates the subject's own sense of the causal implications among the constructs.

The problem is that direct-measure and self-report techniques, both designed to quantify and explicate the

structure of construct systems, provide divergent and sometimes contradictory views of the construct-system structure and have developed independently without regard for convergent conceptualization of this methodological problem. In a direct comparison, Klion (1987) found that examples of the two types of measures tended to correlate highly with similar measures and not at all with measures of the other type. An earlier study of construct superordinacy measures (Bannister and Salmon, 1967) produced similar results; the only significant correlations between measures were between measures of similar type. Some of this may be due to differences in procedure; as Landfield and Epting (1987) point out, the implication-grid procedure uses the client's insight and self-report into relationships among constructs, whereas the other measures derive the relationships directly from grid data.

Although the majority of research efforts to reveal grid structure has used the direct-measure method, neither basic approach has sought to validate its claim to legitimacy by demonstrating changes in construct-system structure consistent with Kelly's concept of dynamic change as elaborated by the organization and modulation corollaries. Indeed, there exists considerable diversity among the direct-measure approach

to measuring multidimensionality and construct superordinacy that must be addressed before it is possible to resolve the apparent contradiction suggested by Klion's (1987) and Bannister and Salmon's (1967) results indicating no relationship between the two types of measures. This study will take the more widely used direct-measure approach and evaluate these measures of construct superordinacy in terms of Kelly's predictions about construct-system change. A clearer understanding of the direct-measure technique is necessary before the direct-measure vs. self-report discrepancies can be resolved.

The purpose of this study was to relate various direct-measure methods of assessing construct superordinacy to actual changes in construct systems over time. Previous studies have compared direct-measure superordinacy measures to each other (Bannister and Salmon, 1967) and individual superordinacy measures to single aspects of construct change (Ryle, 1975), but no systematic comparative survey of competing direct-measure superordinacy techniques has been done that evaluates them in relation to theoretically meaningful construct system change. A comprehensive review of these measures and assessment of their adherence to Kelly's predictions about construct-system revision is necessary to resolve

the current confusion surrounding the relative merits of these different superordinacy criteria.

This study used two different methods of assessing actual construct-system change. The previously used and relatively straightforward method of quantifying construct stability by summing the differences of ratings made with a single construct from one administration to another (element consistency) was supplemented by another measure of construct stability, the stability coefficient. This was derived by calculating the correlation between the ratings on the elements for the two administrations. Various direct-measure methods of assessing superordinacy were compared to both of these measures of construct-system change, and the implications for the utility of these measures were discussed. All of these direct-measure methods take slightly different approaches to evaluating superordinacy and were included in this study in order to compare all major superordinacy measures to each other, and to attempt to establish some sense of cohesion and perhaps convergent validity among these disparate measures. Perhaps this will enable investigators to return grid methodology to its original base--Kelly's theory.

CHAPTER 2
REVIEW OF LITERATURE

There are several areas of literature and empirical research that apply to the present study. First, considerations of grid design and administration will be reviewed. Secondly, scalar measures derived from the grid will be evaluated as they relate to the concept of change postulated by Kelly. Next, non-scalar measures such as principal components analysis will be reviewed and critiqued in regard to their utility in mapping changes in construct systems. Finally, Kelly's theory of construct-system change will be reviewed and applied to this methodology, and specific hypotheses will be derived from this discussion.

Repertory Grid Format and Administration

This section will review the history of grid methodology, discussing grid-format changes and their relation to Kelly's theory. The relationship of grid format to the measures derived from the grid will also be reviewed. Particular attention will be directed toward topics that have a direct bearing on the design of the

grid used in this study, notably bipolar versus graduated ratings and elicited versus supplied constructs.

Kelly's Original Grid Format

Kelly's original technique for gaining understanding of how subjects organized and interpreted their world was to have the subjects articulate the dimensions that they used to discriminate among people and to classify people known to them along these dimensions. A representative sample of these dimensions was elicited by having subjects first select individuals known to them to fill a list of role descriptions (father, mother, best friend, pitiable person, etc.). These persons were compared three at a time, and the subject was asked to describe how two of these persons were alike in a way that made them different from the third. The word that described this similarity, when paired with its opposite, formed a dimension that Kelly believed was personally meaningful and useful for the subject in classifying people. Kelly called these dimensions constructs and viewed them as bipolar and categorical in nature; ratings were done by assigning an acquaintance to one or the other pole of a construct (Kelly, 1955). The grid consisted of the matrix of ratings formed by rating all persons on the list of role descriptions using all elicited constructs

and was a mathematical representation of part of the subject's interpersonal psychological space.

The idea that constructs were functionally defined was one of Kelly's original premises for his theory of personal constructs. How a construct was used was more important than the verbal label used to express its meaning to others. To Kelly, an individual's construct system was a complex interweaving of implicative links among the individual constructs, and the quantification of these links was necessary to understand how the construct system functioned and changed over time. A study of the functional relationships among constructs provided information about similarity between constructs, the hierarchical relationships among constructs, and other structural properties that related to the perceptions and behavior of the individual (Adams-Webber, 1979).

Later Modifications of Kelly's Format

One class of subsequent variations of this basic format involved using either rank-order or Likert scales to classify the persons being rated (elements). In this way, gradations of meaning along the construct dimensions could be assessed, and more detailed information could be obtained about the usage of constructs. This modification preserved the bipolarity of Kelly's

definition of constructs but replaced his categorical, binary system of construct usage with ranking and other quantifications of the interpersonal judgments comprising the grid (Bannister, 1963; Adams-Webber, 1987; Bell, 1990). Likert-scale rating techniques similar to semantic differential methodology (Osgood, Suci, and Tannenbaum, 1957) have been the most commonly used form of recent repertory-grid administration (Fransella and Bannister, 1977; Neimeyer, 1985). According to Kelly, the repertory grid revealed aspects of the relationships among the constructs and elements in the subjects' construct systems that would enable the researcher or clinician to understand the unique way in which the subjects perceived, interpreted, and predicted their interpersonal environment.

In addition to the relationships among the constructs, the relationships among the people being rated (elements) could also be assessed. Kelly, however, saw constructs as logically prior and elements as secondary to the analysis (Adams-Webber, 1979). He was primarily concerned with explicating the relationships among the constructs. In other words, the clinical utility of the repertory grid arose from its ability to clarify the structure of the subject's construct system, showing which constructs were used in similar ways, how

these constructs differed from other groups of constructs, and how elements were alike or dissimilar along the dimensions defined by these groups of constructs.

Reliability Studies of Elicited Constructs

The convention of using constructs elicited directly from each subject rather than supplied by the experimenter reflected the emphasis in personal construct theory on the idiosyncratic nature of each person's system of cognitive dimensions for interpreting their social environment. Kelly assumed that the constructs that were elicted from people by means of his method of triads were a representative sample of those dimensions that they used to construe their own behavior as well as the behavior of other important people in their lives. This assumption was supported by several studies testing and confirming the hypothesis that eliciting constructs on two different occasions would produce considerable overlap in the two sets of constructs.

Hunt (1951) found when comparing two sets of constructs elicited using the triad procedure on a different set of elements one week later that a sample of psychiatric inpatients and college students produced constructs judged by themselves to be the same or almost the same approximately 70% of the time. Fjeld and

Landfield (1961) compared grids given to 60 undergraduates twice with a two-week interval between administrations. The experimenters developed a construct-category dictionary to classify constructs and evaluated the two sets of constructs on similarity as shown by inclusion in the same category. Subjects' construct categories agreed approximately 78%-80% of the time, regardless of whether the readministration was with the same elements or different elements, or whether the grid was administered by the experimenters or was self-administered. Sperlinger (1976) used a modification of Landfield's construct categorization system and reported a 56% agreement level between two sets of constructs. However, his interval between tests was seven months, so lower figures could be expected.

Reviewers of these and similar studies (Bonarius, 1965; Bannister and Mair, 1968; Adams-Webber, 1979) conclude that this duplication of constructs supports Kelly's assumption that the construct elicitation procedure produceed mostly pre-existing constructs, that these constructs were permeable (that is, applicable to a wide variety of elements), and that they were a representative sample of the person's constructs. The subjects seemed to be capable of providing no more than twenty or thirty constructs at any given time before

repeating themselves, so, according to Bannister and Mair, "There is no fear of being confronted with the everlasting pages of an infinite personal directory" (1968, p. 58). The consensus among current theorists is that grids employing ten or more constructs are satisfactory for most purposes, and grids with more than twenty constructs are measuring no more of the properties of the construct system than smaller grids. Slater (1977) reported a modal size of 15 constructs and 12 elements in a sample of more than one thousand grids from various sources. However, the question of whether these constructs should be elicited or supplied remains.

Elicited versus Supplied Constructs

A common variation on the original grid-administration technique consisted of supplying rather than eliciting the bipolar dimensions used to rate the elements. The advantage of supplying constructs was that it made grid administration easier by eliminating the construct elicitation procedure. It also eliminated variability due to subjects' different approaches to the elicitation task and their varying abilities to conceptualize and abstract similarities and differences. In experimental studies of the grid's structural properties, the main advantage of supplying constructs

was that it permitted a higher degree of standardization in administering grids as a basis for intersubject or intergroup comparisons.

Supplying constructs represented a major departure from Kelly's own emphasis on the personal and unique nature of each individual's construction processes (Adams-Webber, 1979). The potential disadvantage was that the supplied constructs might include errors of commission or omission when compared to the subject's individual construct system. Bannister and Mair (1968) complained that "The procedure of supplying adjective labels has become more widely favored than can be theoretically or experimentally justified" (p. 153). However, they offered no experimental proof of this and thus were objecting on theoretical rather than empirical grounds. Several ways exist to test this hypothesis, and the relevant studies will now be reviewed.

Meaningfulness ratings of elicited constructs. There is evidence that constructs that are elicited from subjects individually are rated as more personally meaningful to those subjects than are some sets of constructs supplied to them from other sources. Oswalt (1974) compared 3,800 descriptors of personal acquaintances elicited from eight undergraduates. He found that of the total number of different words used by

his subjects, only about 25% were used more than once. Oswalt reasoned that this proliferation of descriptors reflected subtle shades of meaning obscured by methodologies such as Fjeld and Landfield's construct dictionary and that subjects had very specific words that they used to describe certain people. His subjects were able to name with 85% accuracy the person being described when presented with descriptors that they had used more than once to describe the same person. From this it can be inferred that a supplied set of constructs may not give the subject the opportunity to discriminate maximally among the people being rated.

Research directly comparing elicited and provided constructs (e.g., Isaacson and Landfield, 1965; Adams-Webber, 1970) generally supports Bonarius' (1965) statement that "The research has shown convincingly that the individual prefers to express himself and to describe others by using his own personal constructs" (p. 42). However, this increase in meaningfulness is usually assessed either by the subjects' ratings or extremity of rating when the construct is used to classify people, not by structural properties of the grids themselves or any theoretically derived indication of meaningfulness. One such study (Landfield, 1971) had psychotherapy clients rank order a set of constructs, half of which were theirs

and the other half their therapist's, in terms of their felt usefulness in describing others. Landfield found that the five constructs judged to be most useful were more likely to be the client's and the five least useful usually those of the therapist. A major limitation of these experiments was that they merely established a preference for one's own constructs and did not demonstrate an effect on grid measures caused by using elicited rather than supplied constructs. The practical question of what effect type of construct has on response to the grid was not addressed.

Comparisons on structural measures. Various researchers and reviewers (Fransella and Bannister, 1977; Bannister and Mair, 1968; Leitner, Landfield and Barr, 1976; Adams-Webber, 1979; Bell, 1990) have argued both sides of this debate. Those favoring elicited constructs stress the necessity of capturing the individuality of each person's construct system. Those favoring supplied constructs point out that it is impossible to supply a construct, only a label that is still subject to individual interpretation and application. Several studies actually comparing the two types of constructs on structural measures (Tripodi and Bieri, 1963; Bieri, 1966; Warr and Coffman, 1970) have shown no difference between grids with elicited as opposed to supplied

constructs on structural measures. All of these studies used provided constructs that represented one of the three main dimensions of evaluation, activity and potency found in semantic differential research (Osgood, Suci and Tannenbaum, 1957). These dimensions were adequately represented by selecting constructs that loaded highly on these dimensions.

Representativeness of supplied constructs. Most current work (e.g., Adams-Webber, 1990) is done with grids containing supplied constructs loading heavily on the three semantic differential components, leaving it to the subjects to use these in a way that will express individual differences in construing. Adams-Webber and Benjafield (1973) found that, even with a supplied set of constructs, extremity of rating varied according to the subjects' judgments of construct usefulness, with more extreme ratings being used for more important constructs. According to Adams-Webber (1979),

> A working assumption of many users of repertory-grid tests is that, although persons may prefer to use a particular set of constructs to interpret their social environment, most people are practiced in communicating their personal judgments to others in terms of a fairly wide range of common adjectives. Thus, they can be expected to make the same discrimations among people, within limits, whether they employ constructs elicted from themselves or supplied adjectives. (p. 24)

This concept of shared meaning is supported by Kelly's (1955) sociality corollary, which states that interpersonal relationships are made possible by construing the construction processes of another; that is, being able to relate one's own constructs to those used by others, with the implicit assumption that these constructs are communicated and referred to by verbal labels. Bannister and Mair (1968) assume that "They would all share some common understanding of these terms and such commonalities would provide a fair basis for comparisons of structural features of construing" (p. 39). Bell (1990) also supports the adequacy of a representative set of supplied constructs; most if not all subjects can convey their unique perspectives on their interpersonal universe using supplied constructs.

Extremity ratings of elicited constructs. Another area of difference between elicited and supplied constructs is in the higher proportion of extreme ratings used with elicited constructs, which is consistent with the findings that subjects rate elicited constructs as more meaningful. The inference is that extreme ratings denote more meaningfulness, and therefore elicited constructs are superior to supplied ones. This assumption about extremity has been challenged, with extremity being interpreted as both an indication of

maladjustment (Arthur, 1966; Hamilton, 1968) and as an artifact of ratings on concrete, categorical constructs such as gender, occupation or physical characteristics.

Whatever the significance of this difference in extremity, it has been observed in numerous comparisons of elicited and supplied constructs. Cromwell and Caldwell (1962) found that subjects' ratings of twelve acquaintances on eleven-point scales based on their own elicited constructs were more likely to be on the extreme ends of the scale than were ratings of the same persons on constructs elicited from another subject. Isaacson (1966) also used a mixture of elicited and supplied constructs and noted a significant difference in extremity. Landfield's (1971) psychotherapy study had clients fill out grids using half of their own constructs and half elicited from their therapist, and he observed a difference in extremity in the predicted direction on self-ratings. However, no significant difference in extremity was found by Warr and Coffman (1970), who attribute this to careful selection of supplied constructs to afford equal representation of the three major semantic differential components: evaluation, activity and potency (Osgood et al., 1957) in their construct set. Again, carefully chosen constructs will provide a sufficiently diverse and comprehensive

selection so that subjects will suffer no penalty in expressiveness when using supplied constructs.

Bieri (1955) developed a modified form of the repertory-grid test, utilizing 10 elements, 10 supplied constructs, and six-point rating scales. This "Bieri grid" was used to assess developmental aspects of cognitive complexity in a number of studies (Bieri, 1955; Bieri et al., 1966). Tripodi and Bieri (1963) compared five elicited and five supplied constructs and found no significant difference in terms of the structural scores. In addition, the rank-order correlation correlation between scores based on elicited constructs and those based on provided ones was .50 ($p<.05$). They conclude that these results "indicate that for research purposes provided constructs are comparable to one's own constructs in measuring cognitive complexity" (p. 235).

Lemon and Warren (1974) cast doubt upon the assumption that rating extremity directly is an appropriate measure of meaningfulness. To them, the meaningfulness of a construct could also be viewed in terms of its implicative potential, or the number of inferences that could be made from that particular construct to other related constructs based on interconstruct correlations. However, they also suggested that, if the informational content of a given

construct used in a Likert-scale grid is organized in terms of an underlying bipolar structure, as Kelly hypothesized, then rating extremity may indirectly reflect meaningfulness. In other words, it is possible that the use of elicited constructs may select for constructs that are more categorical than graduated in their application and thus permit stronger or wider inferences from them, thereby generating clear-cut, that is, extreme ratings. Lemon (1975) argued that the extent to which a construct relates to other constructs could serve as an index of its meaningfulness in the sense that the more constructs that relate to a given construct within an individual's cognitive system, the more specific implications that construct would have for that person.

In summary, although some differences could be found between subjects' usage of elicited and supplied constructs, this difference altered structural properties of the grid only when the supplied constructs were selected in a manner that did not afford representation of the three major dimensions of evaluation, activity and potency discovered in semantic differential research. Supplied constructs standardize and simplify the grid administration sufficiently to justify their use for research purposes.

Scalar Measures Derived from the Grid

Despite Kelly's cautionary remarks about the limitations of a traditional psychometric approach to repertory grids, early studies in construct theory often attempted to measure grids' "properties" by quantifying various structural aspects. This section will review some of these methods and relate the derived measures to Kelly's theory.

Consistency Measures

The consistency of the repertory grid can be evaluated in one of two ways. The stability of the constructs in their ratings of elements over time (element consistency) is one aspect of grid reliability, but equally important are the relationships or functional similarity among the constructs. A subject could change ratings of elements on the constructs to a large degree, thus demonstrating low element consistency, but if the relationships among the constructs did not change, the construct system's structure would remain the same and the grid would be said to have construct consistency (Abams-Webber, 1979). Slater (1972) pointed out that the correlation between any two constructs could remain approximately the same although the categorization of particular figures on each construct has changed

provided that the elements changed in their evaluation on the two constructs in a consistent way.

Kelly saw a change in the structure of the construct relationships to be qualitatively different than a change in the ratings of particular elements on constructs within the system and to indicate a more significant rearrangement of the construct system than a reappraisal of elements. To Kelly (1955, 1969), construct-system change involved a change in the functional properties and hence intercorrelations of the constructs themselves, not the ratings of particular elements on constructs that preserved the same pattern of functional similarity among themselves.

Although Kelly's method of nonparametric factor analysis for repertory grids grouped constructs with the underlying factors associated with them, it did nothing to reduce the dimensionality of the construct space. In general, the constructs were located in a space defined by the elements and this space had as many dimensions as there were elements. Kelly saw constructs as logically prior and elements as secondary to the analysis (Adams-Webber, 1979); he was primarily concerned with explicating the relationships among the constructs. Fransella and Joyston-Bechal (1971) showed that shifts in patterns of construct relationships are not always

accompanied by corresponding changes in the categorization of particular figures on these constructs. Conversely, people sometimes revise their specific impressions of their associates without altering the pattern of relationships between their constructs and thus the logical structure of their conceptual systems. Further evaluations of relationship consistency in repertory grids have been carried out by Bannister (1960, 1962) and Bannister and Fransella (1966). They conducted a series of experiments concerned with the immediate test-retest consistency of the pattern of construct relationships in different forms of repertory grid. Bannister (1960) used a bipolar grid-format to test the degree of statistical association between all construct pairs and then readministered the grid using different figures ranked on the same constructs. A Pearson r of .60 was obtained between the ranks of the construct correlations for each administration. A similar study using photographs of strangers as elements yielded a Pearson r of .71 using the same elements in both administrations.

Bannister and Fransella (1966) assessed relationship consistency again using photographs rated on six different adjectives. Spearman rank-order correlations were again calculated against all possible pairs of

constructs and these two sets of rankings correlated .80. These three studies indicate that repertory-grid techniques provide a consistent measure of the pattern or relationships between subjects' constructs; although they reveal little about the pattern of stability over time.

Element consistency. Slater (1972) pointed out that there are several basic questions which can be raised concerning the reliability of any form of repertory-grid test. The first of these is the problem of whether subjects exhibit consistency over time in the way in which they apply the same constructs to the same figures. This aspect of grid reliability is referred to as element consistency. The problem of element consistency has been studied principally in relation to constructs which have been elicited directly from subjects themselves and figures who are personally known to them. Pederson (1958) randomly selected five constructs from the repertory-grid protocols of his 38 subjects and asked them to reapply these constructs to the same set of figures in a second administration of the test two weeks later. A comparison of the two row patterns of each construct across both grids yielded a median phi coefficient of 0.72 ($p<.005$), which indicates a fairly satisfactory level of element consistency. Fjeld and Landfield (1961) asked 20 subjects to use

the same list of figures and the same set of constructs on two grid tests administered to them two weeks apart. Their subjects exhibited a high degree of consistency in the way in which they categorized figures on each construct as evidenced by the fact that 83% of their judgments were the same on both occasions. However, it must be remembered that the use of bipolar grids such as those used in these two studies will yield higher element consistency scores than grids employing rating or Likert scale systems, since more choices are available to the subject in these latter modifications.

Construct differences in element consistency. Some theoretical reasons exist to explain why constructs differ in their element consistency. Levy (1956) hypothesized that constructs which were members of a cluster of functionally similar constructs were more resistant to change and therefore would demonstrate higher element consistency. He categorized constructs elicited from subjects in bipolar grids into constellatory, or highly intercorrelated, and propositional, or functionally isolated, based on their degree of relationship to other constructs. He then told subjects that some of their ratings in the first administration were incorrect and then readministered the grid, suggesting that the subjects might want to revise

their responses. He observed that ratings of elements on propositional constructs were more likely to be revised than those on constellatory constructs. To Levy, this validated Kelly's original theoretical distinction between the two types of constructs and demonstrated a reliable method of empirically differentiating between them; that is, in terms of the degree of their functional similarity to other constructs in the grid.

Ryle (1975) also compared element consistency among constructs from the same grid, but he operationalized the constellatoriness of constructs on the basis of how much variance they accounted for in the grid as a whole. Using this criterion, it is reasonable to assume that constructs having a larger number of functionally similar constructs in the grid will load on a major dimension of the grid's variance. Thus, Ryle's criterion is roughly equivalent in Likert scale grids to Levy's criterion for bipolar grids. Ryle's study differs from Levy's in another manner; Ryle merely retested the subjects after a twelve to twenty month interval rather than telling them that some of their ratings were in error. In 14 of his 19 subjects, the three constructs accounting for the most grid variance showed higher element consistency than the three constructs accounting for the least grid variance--a result that is consistent with Levy's. However, Ryle's

criterion chose constructs on the basis of their relation to the other constructs in the grid as a group rather than their inclusion in construct clusters. It is unclear how Ryle's criterion would apply to a construct system with a number of large, independent clusters of constructs.

Some Univariate Measures of Grid Structure

Measures of grid structure that yield a single scalar measure of grid organization are not capable of measuring change. They are also not suitable for explicating the parameters of change within a construct system, but there are properties of construct systems measurable in this manner that have a bearing on this change process. Several measures of this type will be discussed both in the context of their relation to construct theory and as they apply to construct-system change.

Kelly's distinction between "tight" and "loose" construing in his development of construct theory led to many attempts by subsequent researchers to quantify this aspect of construct organization. Tight construct-systems, according to Kelly, led to unvarying predictions and lack of adaptability in the face of unanticipated events while excessively loose construing led to the inability to predict and thus revise the construct system

when it failed to lead to specific predictions (Epting, 1984). Although Kelly emphasized that this tightness or looseness was not a permanent attribute of an individual's construct system but merely a temporary attribute that depended upon the circumstances, various measures obtained from grids have been proposed as accurate measures of the "trait" of tight or loose construing. Construct theory methodology has numerous measures of integration, or tight, highly intercorrelated construct-use, and equally numerous measures of differentiation, or functional independence of constructs ("loose" construing). These properties have been quantified in numerous and sometimes incompatable ways and have even been seen as unrelated and independent aspects of construct organization (Crockett, 1982).

Integration and differentiation. Integration, or tight construing, was assessed by Bannister (1960) with an intensity score obtained by calculating all possible interconstruct correlations, squaring the resulting numbers, multiplying by 100 to reposition the decimal point, and summing them. This gave an overall measure of construct intercorrelation and Bannister used this measure in a series of experiments (Bannister, 1960; Bannister and Fransella, 1966, 1967) to establish that schizophrenics' grids showed lower intensity scores and

thus excessively loose construing when compared to normal controls. Intensity has remained the only viable measure of tight construing but there exist several alternative ways of measuring differentiation, or loose construing. The earliest was Bieri's measure of cognitive complexity. Bieri (1955) assigned agreement scores to constructs by comparing them element-by-element and then summing across constructs. The more two constructs rated the elements in identical ways, the higher the agreement total and the lower the level of cognitive complexity. Bieri reasoned that cognitively complex individuals saw the world in a more multidimensional way and this has been supported by studies showing a higher level of role-taking ability and other tests of social perceptiveness in subjects with higher levels of cognitive complexity (Olsen and Partington, 1977). However, the relation between Bieri's measure of cognitive complexity and intensity is not reciprocal: Honess (1976) failed to find a significant relationship between the two scores.

Other methods of assessing differentiation by measuring the dimensionality of construct systems have been developed using matching scores similar to Bieri's, factor and cluster analysis, and multi-dimensional scaling (Fransella and Bannister, 1977). Landfield's

(1971) Functionally Independent Constructs (FIC) scoring method is a form of cluster analysis that groups constructs according to their degree of agreement on the rated elements: constructs that agree on element ratings above a preset level are classified as functionally equivalent and grouped with similar constructs. The FIC score is the number of such construct clusters in the grid. This measure shows a moderate (r=-.67) inverse relationship to intensity (Klion, 1987).

However, attempts to quantify the overall tightness or looseness of construct systems along a single dimension are forced to ignore the structure within the grid and thus confound the tightness within discrete construct subsystems with functional equivalence across subsystems. More sophisticated measures such as hierarchical complexity or factor analysis are needed to assess these two aspects of construct organization independently.

The hierarchical nature of constructs. One of Kelly's basic premises was that the individual system of interrelated constructs is hierarchical in nature. According to the organization corollary, "Each person characteristically evolves for his own convenience in anticipating events a construction system embracing ordinal relationships among constructs" (Kelly, 1955,

p. 56). To Kelly, this hierarchical structure is as individual as the constructs used and "It is this systematic arrangement which characterizes the personality, even more so than do the differences between individual constructs" (Kelly, 1955, p. 56).

Kelly hypothesized that some constructs subsumed, or contained, others, forming a higher level of organization of which the other constructs were particular examples. These superordinate constructs usually had a wide range of convenience: that is, they could be applied to a wider range of elements than subordinate constructs. An example of such a superordinate construct would be "good-bad"; other constructs such as "beautiful-ugly", "honest-dishonest", and "intelligent-stupid" are subsumed by good-bad because assignment of an element to one pole of the superordinate construct would usually determine which pole of the subordinate constructs would be applied to that element. In this example, "bad" would include all elements that are rated as "ugly", "dishonest" or "stupid", plus some other elements that are neither honest nor dishonest, etc.

Obviously, superordinate constructs would be functionally similar to the constructs which they subsume, but may also have functional similarity to constructs that are subsumed, along with them, by still

more superordinate constructs. However, Kelly cautioned against an implicative determinism in modeling construct systems, pointing out that superordinate constructs may apply in relativistic as well as absolutistic forms and that the ordinal relationship between constructs may reverse itself from time to time as the construct system undergoes revision.

This hierarchical structure and the technique for measuring it were not addressed by Bieri's, Bannister's, or Landfield's univariate measures. Landfield's analysis identified clusters of constructs as being functionally similar using arbitrary cut-off points (e.g., agreement on 80% of the elements) but provided no method of identifying which of the constructs within the clusters were superordinate and did not provide a measure of between versus within cluster variance. A separate, smaller group of techniques has evolved to deal with this theoretically significant aspect of construct system organization.

Smith and Leach's hierarchical measure. Several studies have adopted a hierarchical approach to assessing the structure of an individual's personal construct system. Smith and Leach (1972) employed an elaborate analysis of repertory grids employing cluster analysis to group figures and constructs and then reanalyzing these

grids after collapsing all figures and constructs found to be similar in the first analysis into a single entity. The greater the observed change in the groupings of figures between the first and second analysis the higher a subject's score on this measure, which Smith and Leach called hierarchical complexity. They were attempting to quantify the vertical multidimensionality of the construct system, not the horizontal diversity as measured by Bieri (1966). Not surprisingly, this measure does not relate highly with Bieri's measure of cognitive complexity (r=.10, r=-.34 in successive samples) and apparently measures another aspect of the construct system. The main advantage of Smith and Leach's procedure for assessing hierarchical complexity seems to be that it does not correlate too closely with Bieri's index of differentiation between constructs and thus provides a way of measuring an independent aspect of construct system structure.

Smith and Leach, Bieri, and Landfield all developed methods that differed in procedure, but they shared a common criterion for grouping constructs: constructs that sort the elements in similar ways are judged to be similar. For the purposes of this study, this will be called the functional-similarity criterion for grouping

constructs, and treated as one approach to identifying construct system structure.

Hinkle's hierarchical measure. Hinkle (1965) studied the hierarchical structure of construct systems using a modification of the original grid format. Rather than rating elements on constructs, Hinkle asked the subject what effects changing the subject's evaluation of themselves on a particular construct would have on the self-evaluation on the other constructs. All possible construct pairs were compared twice, once in each direction (i.e., "will changing on construct one cause you to change on construct two?" and vice versa). In this way, Hinkle evaluated the implicative linkages among constructs and thus could evaluate constructs in terms of their superordinancy: constructs having many implications (caused many other construct ratings to change when they were changed) were superordinate to constructs with fewer implications. Hinkle went on to show that, as Kelly predicted, constructs that were superordinate by this criterion were more resistant to change than subordinate constructs.

Hinkle also developed a method for eliciting progressively more superordinate constructs by a process he termed "laddering". The subject was asked why one pole of an elicited construct is preferable to the other

and this descriptor, along with its opposite, became a more superordinate construct with the process being repeatable with the new construct. Hinkle demonstrated that such constructs were superordinate in that they had more implications for change than the constructs from which they were derived.

This method of eliciting constructs was useful for producing superordinate constructs but was artificial in that it did not representatively sample the construct system of the subject and thus did not provide the subject with the constructs they customarily used to classify their experiences. It did demonstrate that structural properties related to superordinancy did exist and that superordinate constructs were more resistant to change and thus could be expected to demonstrate higher element consistency. An additional criticism of Hinkle's technique was that it relied on the subject's judgement and was a self-report measure that required the subject to have insight into the relationships among constructs, an assumption Kelly did not make (Landfield and Epting, 1987).

Makhlouf-Norris' hierarchical measure. In an effort to hierarchically organize constructs without having subjects explicitly rate them, Makhlouf-Norris, Jones and Norris (1970) developed a method of identifying

and labeling as superordinate certain constructs in grids administered to both obsessive and normal subjects. After first computing all interconstruct correlations and clustering constructs that met a predetermined significance level, these researchers identified as superordinate those constructs that correlated highly with constructs in more than one of these clusters and thus bridged the gap between groups of highly similar, subordinate constructs. For the purposes of this study this criterion will be referred to as the bridging technique of identifying superordinate constructs.

This operationalization was consistent with Kelly's concept of linkage at a higher level between two or more groups of unrelated constructs and indeed was successful at discriminating between obsessive and normal subjects (Makhlouf-Norris et al., 1970). Normal subjects had more superordinate constructs and a more articulated construct system organization while obsessive subjects had either a more monolithic or a segmented organizational pattern. Makhlouf-Norris' technique was similar to Landfield's (1971) FIC analysis in that it mapped construct system organization on the basis of similarity of construct usage but was diametrically opposed to Landfield's method of identifying superordinate constructs, since it did so by their

linkage between clusters of constructs rather than by inclusion within a cluster.

Studies comparing measures of superordinacy. To clarify the relationships among these disparate measures of hierarchical structure or superordinacy, two comparative studies done by Bannister and Salmon (1967) and Klion (1987) have been informative. However, it must be remembered that the first study compares individual constructs within grids while Klion's work compares overall measures for entire grids.

Bannister and Salmon (1967) compared 10 measures that various researchers had proposed as measures of superordinacy for individual constructs, including extremity of rating, degree of relationship with the most important construct, variance accounted for, resistance to change, laddering, size of loadings on the first factor from principal components analysis (a measure to be discussed in the next section), total loadings on all factors, lopsidedness, subjects' ratings, and range of convenience. Their analysis of the intercorrelations of these measures in an attempt to establish convergent validity for the concept of superordinacy was unproductive. Most of the measures were poorly related to each other and the two clusters of measures that did emerge were, roughly, those derived from quantifying the

total amount of relationship of a construct to other constructs and those involving subjective ratings by the persons completing the grids.

Klion (1987) factor analyzed the correlation matrix of various hierarchical measures of grid structure, specifically Makhlouf-Norris' et al. (1970) measure of articulated structure, Smith and Leach's (1972) hierarchical complexity, Landfield's (1976) chi-square measure of construct ordination (essentially a quantification of the distribution of ratings along the Likert scale), and Hinkle's (1965) implications measure, i.e., the total number of implications in the grid. Klion also included in the analysis several non-hierarchical grid measures such as Fransella and Bannister's (1977) Intensity measure, Landfield's FIC measure of the number of functionally independent constructs, as well as two measures derived from principal components analysis; number of factors extracted and explanatory power of the first factor. His results indicated that both Smith and Leach's and Makhlouf-Norris' measures correlated significantly with measures of overall construct-system organization such as intensity and FIC. Hinkle's implications measure was factorially distinct from these other measures, as was the Landfield chi-square measure of construct ordination.

Klion was comparing measures obtained from the grid as a whole, not measures of individual constructs. Apparently, the measures of hierarchical complexity and articulation were confounded by the overall tightness or looseness of the grid structure in such a manner that these types of structure could only exist in the absence of overall tightness of construing. Again, difficulty operationalizing Kelly's theoretical concept of superordinacy has produced a lack of consensus on its measurement and impeded the development of grid methodology.

Factor and Cluster Analysis of Repertory Grids

Rather than concentrating on interconstruct differences in usage or superordinancy, many investigators have applied various forms of factor or cluster analysis to repertory grid data. These techniques provide a method by which the grid can be represented in such a way that construct similarity is the basis for approximating the complexity of the repertory grid with fewer dimensions. A high level of mathematical sophistication is not required in order to grasp the basic logic of this mode of analysis. In general, it is used to determine which constructs have judged the figures in a similar fashion. Constructs on which the same figures have been grouped, rated, or

ranked in a similar way are found to be closely related to each other and to form a factor. Thus, constructs within the same factor or cluster are more highly related to each other than to constructs within other clusters (Adams-Webber, 1979). This form of analysis yields measures of overall grid structure as well as data about specific constructs within the grid.

Kelly's Method of Grid Analysis

Kelly's own technique of analyzing the original categorical (binary) grid data was an adaptation of multivariate approaches available at the time and was variously described by him as a nonparametric factor analysis or a hyper-space vector analysis (Kelly, 1955). It consisted of clustering constructs into groups based upon their matches (or mismatches, in the case of negatively correlated constructs) and creating hypothetical constructs as the centers of these clusters. Kelly described a method for doing this by hand calculation that closely resembles the centroid method of principal components analysis in its criteria for measuring construct similarity but is actually a form of cluster analysis: the end product is groups of constructs judged to be similar, not factors that are linear combinations of constructs.

The hyper-space in which Kelly was placing the constructs was defined by the elements. A grid comparing twenty people created a 20-dimensional hyper-space in which the constructs were located, each axis of which was defined by an element. In keeping with the nonparametric nature of this analysis, these hypothetical constructs at the center of construct clusters created a reference point to which the actual constructs could be compared. All constructs that matched this hypothetical construct at a preset significance level (e.g., $p<.05$) would be considered to be part of that cluster. The "explanatory power" of this cluster of constructs, or factor, was defined by Kelly as the sum total of all element rating matches between the hypothetical construct and each of the actual constructs that were contained in that cluster (Kelly, 1955; Adams-Webber, 1979). An early reliability study on the stability of the largest such factor (Pedersen, 1958) shows an $r=.83$ test-retest correlation for the loadings of specific constructs on this factor in a group of 38 subjects retested after a two week interval. The explanatory power of the first factor was less stable, with a test-retest correlation of $r=.48$.

Principal Components Analysis of Grids

Kelly's non-parametric analysis technique was developed to be used with the binary form of repertory grid. A comparable method of analyzing rating grids using principal components analysis was developed by Slater (1964, 1965, 1972, 1977). Rather than clustering constructs into groups based on their functional similarity as Kelly's technique did, Slater's technique represented the construct space as defined by axes composed of the successive factors extracted from a principal components analysis of the constructs. These orthogonal factors were arranged in descending order of magnitude based on the variance accounted for by each principal component and each had a magnitude, or eigenvalue, corresponding to this explained variance.

This approach differed from Kelly's in its smaller number of dimensions necessary to describe the construct space and the fact that individual constructs loaded on rather than composed the factors but was similar in that it partitioned the total grid variance into a relatively small number of independent clusters of hypothetical constructs and supplied a method of comparing these hypothetical constructs to the actual constructs. A comparison of Kelly's technique with principal components analysis methods similar to Slater's (Jaspars, 1963)

showed that Kelly's first factor, or the hypothetical construct at the center of the largest cluster of constructs, was a fairly good approximation of the first centroid factor; the factor that accounts for the maximum amount of variance of the constructs.

Hope (1966, 1969) and others (Adams-Webber, 1979; Bell, 1990) have pointed out the innate advantage of principal components analysis over univariate assessments of grid structure. This technique partitions the total variance within a grid into that attributable to construct differences, the part due to element differences, and, most importantly, variance due to construct-element interactions. Consequently, it is no longer necessary to sum or collapse across elements to compare constructs or vice versa: constructs and elements can be considered simultaneously. This is crucial for the study of change within construct systems since measures of construct differences that sum across constructs ignore the pattern of change that determines how construct use is modified.

Principal components analysis is also useful for spatial representation of grid data to better discern relationships among constructs and elements (Slater, 1977; Beail and Fisher, 1988). The most common technique is to plot constructs in a two- or three-dimensional

format, with each axis representing one of the two or three largest components extracted. In keeping with the ability of this type of analysis to simultaneously represent both elements and constructs, the elements can also be plotted on this coordinate system and can be represented in terms of their relations to the constructs.

Measures derived from principal components analysis. In addition to articulation of the factor structure of the constructs and elements, several measures of overall grid structure and individual construct properties are obtainable from principal components analysis. The variance accounted for by the first principal component, or the explanatory power of the first principal component, is simply the eigenvalue of this component and is a fair measure of overall grid integration. It usually correlates in the r = .90-.95 range with Bannister's Intensity measure (Epting, Prichard, Wiggins, Leonard and Beagle, 1991; Klion, 1987) which is the sum of squared correlations of all possible construct pairs.

Comparisons of individual constructs on measures derived from principal components analysis include the size of these constructs' loadings on the first or other

principal components and the amount of overall variance in the grid that the individual constructs account for. In addition, individual constructs can be evaluated in terms of their similarity to each other by measuring the angle between them in the space generated by either the constructs or the principal components (Hope, 1969; Slater, 1977).

Two of the previous uses of principal components analysis to develop measures of construct superordinacy have explored the properties of constellatory versus propositional constructs. Kelly distinguished between constellatory constructs (those with a large number of implicative linkages) and propositional constructs (those with relatively few linkages). A reasonable criterion for a constellatory construct in the context of Kelly's definition would be one that loads highly on a general factor in either Kelly's or Slater's analysis technique. Levy (1956) used factor analysis to distinguish between constellatory and propositional constructs in subjects' grids on this basis and found that, when told that their original construct ratings of hypothetical people were in error, the subjects changed their ratings on propositional constructs more often than on constellatory constructs.

Ryle (1975), rather than defining constellatory constructs in terms of their loadings on factors, chose them on the slightly different basis of how much variance they accounted for in the grid as a whole. To determine whether element ratings on these constructs would prove to be more resistant to change over time he gave grids to 19 subjects twice, with a between-test interval of 12 to 20 months, and compared the variance accounted for by the three constructs with the highest element consistency to that of the three constructs with the most element variability. In 14 of the 19 subjects, the constructs with the highest element consistency also accounted for more of the variance in the grid. This definition of constellatory constructs would be true for construct systems with a monolithic organization, or a single cluster of constructs, but would obscure the picture in construct systems with two or more separate clusters of intercorrelated constructs.

To Adams-Webber (1979), this would indicate that constructs closely associated with the first factor may be more stable over time in terms of element consistency as determined by comparison of grids given on two different occasions. Furthermore, a higher amount of inconsistency in the ratings on propositional constructs may introduce extraneous variance into the grid and

account for the fact that, although the construct content of this first factor is relatively high (r=.83; Pedersen, 1958) the explanatory power, or variance accounted for by this factor, is only 50% of the total (Bonarius, 1965).

The major purpose of this study is to compare the three previously discussed structurally derived methods of assessing superordinacy to actual construct system change as measured by element consistency and the construct stability coefficients. Briefly, these three techniques are:

1) the degree to which the construct loads on the first component of a principal components analysis of the grid (Ryle, 1975)
2) Makhlouf-Norris' identification of linkage constructs forming connections between groups of highly correlated constructs
3) the Landfield--Smith and Leach method of identifying as superordinate those constructs that are most centrally located in clusters of constructs

These measures will be calculated and compared to element consistency and construct stability to determine if and to what degree they provide evidence of convergent validity for the concept of systematic construct system

reorganization, and the role of superordinate constructs in that change.

Overview and Hypotheses of the Present Study

In reviewing the literature on both superordinacy and overall grid structure and change, several areas of confusion have emerged that the present study wishes to address. The most central of these is the process by which construct systems change and the lack of empirical studies that demonstrate this process. The central role of change in personal construct theory has been scantily supported with research that bears directly on the methods by which construct systems are reorganized and no studies exist that quantify the overall reorganization of construct relationships.

Construct-by-construct comparisons will be used to assess the superordinacy of constructs by various measures currently in use in construct methodology. These direct-measure methods are derived from a single administration of the grid and are based on structural properties of the grid, but they rely exclusively on patterns of construct relationships in the first administration. This study will compare them to element consistency, the stability of ratings on the construct over time, which is a dynamic measure more in keeping with Kelly's theory of construct system organization.

The two previous studies in the literature that compared more than two of these measures (Bannister and Salmon, 1967; Klion, 1987) consisted of correlational and factor analysis techniques, respectively, and did not include element consistency as a criterion variable. By simultaneously assessing all of these measures of construct superordinacy and quantifying the degree of relationship among them it is expected that the relative merits of each as a measure of superordinacy will be clearer.

Hypothesis 1: Following Ryle's (1975) finding that constructs accounting for more grid variance will demonstrate higher element consistency, it is predicted that constructs that load more on the first factor will have a greater degree of element consistency.

Hypothesis 2: Constructs that have higher loadings on the first factor will have higher stability coefficients.

As explained in the review of previous studies, there are two basic and competing criteria for identifying constructs as superordinate. The Landfield - Smith and Leach "functional-similarity" criterion classifies as superordinate those constructs that are functionally similar to the greatest number of other constructs. This contrasts with the Makhlouf-Norris "bridging" criterion which identifies as superordinate those constructs that are functionally similar to constructs that are themselves unrelated and hence

bridge the gap between construct subsystems by linking unrelated construct clusters.

A comparison of these two techniques is proposed that would evaluate their relative effectiveness in assessing construct superordinacy as shown by element consistency. The Makhlouf-Norris bridging criterion is closer to Kelly's theoretical position on construct system organization because it operationalizes the linking function of superordinate constructs proposed by Kelly. This contrasts with the functional-similarity criterion of Smith and Leach and Landfield which requires only a large number of significant similarities in construct usage, a trait shared by both superordinate and subordinate constructs. In addition to assessing both methods' relationship to element consistency, they will be compared to each other to determine which technique is superior in predicting element consistency.

Hypothesis 3: Constructs meeting the Landfield - Smith and Leach functional-similarity criterion for superordinacy will have higher element consistency and construct stability than those not meeting this criterion.

Hypothesis 4: Constructs meeting the Makhlouf-Norris bridging criterion for superordinacy will have higher element consistency and construct stability than those not meeting this criterion.

Hypothesis 5: Constructs that meet Makhlouf-Norris' bridging criterion for superordinacy will have higher element consistency and construct stability than those meeting the Landfield--Smith and Leach functional-similarity criterion.

In order to test these hypotheses, grids were administered to a group of subjects and then readministered a month later using the same elements and constructs. The following measures were computed for the individual constructs: Landfield's FIC measure, Makhlouf-Norris' linkage construct measure of superordinacy, element consistency, stability coefficients for each construct, loadings on the first principal component for the first grid, loadings on all principal components for the first grid, and total variance explained.

In addition to these individual construct measures, the eigenvectors and eigenvalues for the first grid were calculated. The above hypotheses were tested, and the results interpreted.

CHAPTER 3
METHODS

The purpose of this study was to compare various measures of superordinacy for individual constructs to element consistency and construct stability in order to evaluate their relationship to each other and their applicability to Kelly's predictions of construct system change. This section will describe the subjects used in this study, the instruments, the research design, and the statistical analysis.

Subjects

Subjects were 90 University of Florida undergraduates, 60 of whom were obtained from the subject pool of all students taking a general psychology class, and 30 of whom participated as part of a class requirement for a personal growth psychology class. All subjects were administered a repertory grid twice with a three to four week interval between administrations. The experiment was described to the subjects at the beginning of the first administration as a way of determining whether or not interpersonal perceptions changed over

time, and they were debriefed and thanked for their participation after the second administration.

Of the 90 subjects selected, 84 returned completed grid forms for both of the administrations. Six of these grids were not used in the analysis due to double entries on the Likert scales, failure to identify the positive pole of each construct, or other indications of noncompliance with instructions. A total of 78 grids were retained from the original sample for analysis.

Instruments

The instrument used in this study was the repertory grid. As described in the literature review, numerous variations of the grid exist, and the modifications in design have effects on the grid's ability to measure the structure of the construct system. The choices made in the design of the grid used in this study will be explained in terms of previous findings and justified in relation to the purpose of this study.

Size of Grid

The number of constructs and elements in grids is one of the many unstandardized aspects of grid methodology. The larger the grid, the more information is available, but previous studies have shown the inability to meaningfully use more than twenty or so constructs in one grid (Bell, 1990; Adams-Webber, 1979).

Subject fatigue considerations also place an upper limit on grid size. However, overly small grids are incapable of capturing the complexity of construct systems and are useless in testing all but the most basic hypotheses in construct system theory. A lower bound of ten and an upper bound of twenty constructs is generally accepted by reviewers of grid methodology as acceptable for grids that capture the essential structure of the construct system (Bannister and Mair, 1968; Adams-Webber, 1979). Accordingly, a grid size of 15 constructs and 11 elements was selected for this study. The smaller number of elements is still sufficient to allow the constructs to be differentiated from each other, since 11 elements allow 2 to the 11th power or 2,048 possible sorts for sidedness alone. The smaller number of elements still sampled people known to the subject adequately without unnecessarily extending the testing process.

Elements Selected

The role descriptions list supplied to the subjects (Appendix B) contained 11 of Kelly's 20 role descriptions that he listed in his sample grid (Kelly, 1955). Because of the relatively young age of subjects used in this study, all family roles were retained, and comprise 6 out of the 11 elements (father, mother, brother, sister, spouse/lover, ex-lover). The two peer relationships

(current and ex-pal) were retained, as well as a liked and a disliked professor because of the salience of these figures for this age and occupational group. Finally, the self was included as an element because of its centrality to the process of interpersonal perception (Adams-Webber, 1990).

Elicited versus Supplied Constructs

Supplied constructs were used in this study in order to provide greater standardization between the first and second administration. This ensured that changes in the grid ratings would be due to actual changes in the construct system, not such artifactual effects as failure to remember the context of some idiosyncratic construct. As mentioned earlier, a possible problem with using provided constructs is that the subjects may find them less meaningful and relevant to the important dimensions of their individual construct system. Consequently, measures derived from the resulting grid would not reflect nuances of individual diversity. However, several studies have demonstrated that carefully selected supplied constructs result in grid structural measures no different from those derived from elicited construct grids (Bieri, 1966; Warr and Coffman, 1970). For this reason, supplied constructs that adhered to the selection criteria used by these researchers were used.

Choice of Supplied Constructs

In studies of elicited versus supplied constructs, certain types of constructs were found to provide more representative samples of the subjects' important interpersonal descriptors than others; specifically, those that represented Osgood, Suci and Tannenbaum's (1957) three semantic differential dimensions of evaluation, potency and activity. Bieri (1966) and Adams-Webber (1990) have used such a group of standardized constructs and constructs from Bieri's grid were employed in this study. The list of supplied constructs in this study (see Appendix C) afforded approximately equal representation to each of the Osgood et al. dimensions.

Grid Format

Recent work comparing different grid formats (Epting, Prichard, Wiggins, Leonard, and Beagle, in press) has found that grid formats with all ratings arrayed in a matrix resulted in grid ratings with a less complex structure and a larger general first factor than grids where the subject must rate each element on the constructs without visual access to their previous ratings of other elements. An additional finding was that use of Likert scales rather than writing a digit in the array of ratings also was associated with an increase

in multidimensionality of grid structure. Since the present study relied on this grid complexity for a number of its measures, a format that allowed the complexity to be expressed would be preferable to others that minimize it and so the elements were written at the bottom of leaves that contained a Likert scale for each construct rating. These were flipped through one at a time during the completion of the grid, thus reducing possible response bias effects due to comparings ratings on different elements (see grid form, Appendix C).

Procedure

Subjects were provided with a set of written instructions (Appendix A), a role list (Appendix B), and the grid form (Appendix C) at the beginning of each grid administration. To complete the grid, subjects first supplied names of people they knew that fit the 11 roles on the role list (self, father, mother, best same-sex friend, etc.). The 15 bipolar descriptors, or constructs (shy--outgoing, team leader--team follower, etc.) were written on each side of the grid form, with half of each pair being written on each side of the leaves in the center of the form. The 13-point Likert scales were on leaves in the middle of the grid form with each scale aligned with one of the 15 constructs. The subjects were

instructed to transfer the names from the role list to each of the 11 leaves.

To complete the rating process, the subjects were told to look at the first construct (outgoing--shy) with outgoing on the left side of the form and shy on the right and decide which adjective applied to the first element (themselves). If the subjects believed that they were more outgoing than shy they were to circle the numeral on the Likert scale that approximated the degree to which they were outgoing. In this manner, one rating was made on each of the 15 constructs to describe themselves and the first of the leaves was then folded up. This process continued with the second element (mother) on the second of the leaves, the father on the third, and so on, until all 11 of the elements were rated on all 15 constructs. At the end of the rating process, a checkmark was placed by one pole of each construct to indicate which of the two poles that the subject was preferable in general.

Research Design and Statistical Analysis

Because this study focused on the changes that occur in repertory grids in the process of revision over time, no experimental manipulation per se was involved. Rather, the goal was to compare several structurally derived measures of construct superordinacy to the

theoretically meaningful criterion of element consistency and to each other. These two areas of investigation will be treated separately in this discussion.

Criterion Measures

This study dealt with three measures of superordinacy and their hypothesized relationship to element consistency and construct stability. The original methods of calculating these criterion measures will be reviewed and modifications necessary for this study will be discussed.

Of primary concern in comparing constructs in this manner was that the superordinacy measures for each construct should assess superordinacy only relative to other constructs in the individual grid that contains it, not to constructs in other grids. Such intergrid comparisons were meaningless unless some method of controlling for differences in overall grid integration and other properties that affect several of these measures. In order to attain a sufficient number of constructs for hypotheses to be tested, constructs from different grids must be compared, so analyses of association must account for this variation in grid differentiation and integration.

Element consistency. The criterion variable, element consistency, was calculated for each construct for each subject by simply adding the absolute values of all ratings changes on the 11 elements. Since a 13-point scale was used, this allowed a maximum difference of 12 points between ratings, and with 11 elements being rated, the total element consistency score for each construct ranged from 0 to 132, with 0 representing no change from the first to the second grid, and 132 representing total reversal of all ratings. This score was then multiplied by -1 to allow larger numbers to represent higher consistency.

Construct stability coefficient. The second criterion variable, the stability coefficient for each construct, was calculated by correlating each construct's ratings for the 11 elements on the first grid administration with their ratings on the second administration.

Proposed Measures of Superordinacy

In addition to the criterion measures of element consistency and construct stability, the measures hypothesized to be related to them were also calculated. Again, transformations necessary to allow the appropriate analyses to be made were required in some cases.

Loadings on the first factor. This measure of construct superordinacy was calculated by performing a principal components analysis on the first grid administered, and assigning to each construct its respective coefficient in the first eigenvector. Since the eigenvectors are normalized, no adjustment is needed to correct for intergrid variation. The test of Hypothesis 1 was performed by calculating the correlation between this loading and element consistency, with a significant positive correlation being predicted. Similarly, Hypothesis 2 was tested by correlating the factor loadings with the construct stability coefficients after an arcsin transformation was performed on these stability coefficients to normalize their distribution.

Functional-similarity measure. The Landfield - Smith and Leach functional-similarity measure of superordinacy for constructs was derived from hierarchical cluster analysis of the first administration grids. This technique allows for identification of constructs that are more similar to others by explicating the structure on the relationships among constructs. Constructs were classified as either central to or peripheral to the clusters of constructs that are identified by cluster analysis, depending on the degree

of their relationship to other constructs in their cluster. Constructs that are similar in usage to others in the cluster were classified as functionally similar, and assigned a score of 1, with others assigned a score of 0.

The test of Hypothesis 3 was made by comparing this measure with the measure of element consistency and construct stability, using linear regression. It was predicted that these associations would be positive, i.e., higher degrees of functional similarity to other constructs would be associated with a higher levels of element consistency and construct stability.

Bridging measure of superordinacy. Makhlouf-Norris et al.'s measure was computed as described in the original work reporting this technique (Makhlouf-Norris, Jones, and Norris, 1970), with some important modifications designed to overcome two limitations of the original measure.

This measure of articulated structure originally quantified superordinacy by the following technique. First, all interconstruct correlations were correlated, and all constructs that were intercorrelated at the $p=.05$ significance level were classified as members of that construct cluster. Superordinate constructs were defined as those who were correlated highly with those in

more than one of the clusters. These were assigned an arbitrary score of 1, and all other constructs were assigned a score of 0.

To make this measure a more accurate measure of the linking properties of such constructs, hierarchical cluster analysis was used rather than the original correlational approach of Makhlouf-Norris et al. This allowed the constructs that linked pre-existing clusters of constructs to be assigned a score of 1, and all others a score of 0.

Having derived this measure, Hypotheses 4 and 5 were tested using a linear regression model to quantify the degree of association between the Makhlouf-Norris measure and both element consistency and construct stability, as well as comparing the Makhlouf-Norris measure and the Landfield--Smith and Leach functional-similarity measure on their degree of association with the criterion variables. Hypothesis 4 predicted that the association between the Makhlouf-Norris bridging measure of superordinacy and the two criterion variables would be positive and significant. Hypothesis 5 predicted that the Makhlouf-Norris measure would relate to a stronger degree to the criterion variables than the Landfield - Smith and Leach functional-similarity measure of

superordinacy. T tests were used to compare the Makhlouf-Norris to the Landfield--Smith and Leach superordinacy constructs, with higher element consistency and construct stability predicted for the Makhlouf-Norris criterion constructs.

CHAPTER 4
RESULTS

This study was designed to compare several measures of construct superordinacy. The primary analyses tested hypotheses about the relations among these superordinacy measures. They consisted of linear regression tests of significance for comparisons of continuous variables and analyses of variance for comparisons of categorical and continuous variables. The SAS statistical package was used for all statistical analyses and all were done at the University of Florida computing center. The results of these analyses will be reported in this chapter as well those of supplemental analyses suggested by the results.

Seventy-eight subjects completed two administrations of the repertory grid. The results of these grids were then analysed to compute the two criterion variables of element consistency and construct stability for each construct. In addition, the first administration for each subject was subjected to cluster analysis to find groups of related constructs and to identify as

superordinate by the Makhlouf-Norris bridging criterion as well as the Landfield-Smith and Leach functional-similarity criterion. Finally, principal components analyses were performed on each of the first administration grids to determine the loadings on the principal components for each construct.

Transformation and Normalization of Variables

Inspection of the distribution of the variables revealed some skewness in the distribution of the element consistency measure, with a mean value of 16.03 and a standard deviation of 9.76, but with values ranging up to 69. As could be expected in a variable of this nature with values closer to the lower than the upper bound, the mean was closer to the minimum end of the range. Accordingly, a square root transformation was performed on this variable which resulted in a more normally distributed range of values.

Because the stability coefficients were actually correlations of the element ratings between the first and second grid administration, an arcsin transformation was performed on them as well as on the first-factor loadings. This assured these variables would be able to be analysed using linear regression models without violating normality assumptions. Table 1 lists means and standard deviations for all continuous variables.

Table 1. Means and Standard Deviations for Variables After Transformation

Transformed Variable	Mean	Standard Deviation
Element Consistency	-2.2173	.3986
Construct Stability	.6228	.3628
First Factor Loading	.1668	.0486

The Makhlouf-Norris bridging measure and the Landfield--Smith and Leach functional-similarity measure of superordinacy were calculated as described previously. Constructs that were similar above a preset significance level to others in the construct cluster to which they belonged were classified as superordinate by the functional-similarity criterion. Constructs that were similar to constructs that belonged to two pre-existing clusters and formed the initial connection between the two clusters in the cluster analysis as the intercluster distance was reduced were classified as superordinate according to the functional-similarity criterion. Some overlap between the two measures was observed as the

more intercorrelated constructs in a cluster were sometimes also the most similar to constructs in other clusters. Table 2 lists the numbers and proportions of constructs classified as superordinate by these two criteria.

Table 2. Superordinacy Classification of Constructs

Criterion	n	Percent
Makhlouf-Norris bridging	348	29.7
Landfield--Smith and Leach functional similarity	341	29.1
Both Criteria	139	11.9

Results of Primary Analyses

Hypothesis 1 predicted that the principal components analysis loadings on the first factor for each construct would be positively associated with the element consistency measure for that construct. Linear regression analysis showed that the association was indeed significant and in the predicted direction (r = .06543, p=.0252). The degree of association between these variables is very slight, accounting for less than 1% of the variance.

Hypothesis 2 predicted that that the same principal components first-factor loadings for the constructs would be positively correlated with the stability-coefficient measures for that construct. Again, linear regression analysis showed that the association between these two variables was significant (r = .17851, p < .0001).

The third hypothesis predicted a positive association between the Landfield--Smith and Leach functional-similarity measure of construct superordinacy and both element consistency and construct stability. The linear regression analysis revealed a significant positive association between the functional-similarity measure and both criterion variables; $F(1,1168) = 7.60$, $p = .0059$ for element consistency, and $F(1,1168) = 33.66$, $p < .0001$ for construct stability, respectively. These values correspond to correlations of $r = .0848$ and $r = .1674$ between the functional-similarity measure and the criterion variables.

The fourth hypothesis evaluated the Makhlouf-Norris bridging measure of superordinacy in terms of element consistency and construct stability, predicting a positive association between the superordinacy and each criterion variable. Linear regression analysis failed to detect

such an association; $F(1,1168) = 0.69$, $p = .4072$, n.s. for element consistency, and $F(1,1168) = 1.51$, $p = .2198$ n.s. for construct stability.

Table 3 summarizes the linear regression analyses for the two superordinacy criteria compared to both element consistency and construct stability.

Table 3. Results of Linear Regression Analysis of Superordinacy Measures with Element Consistency and Construct Stability

Superordinacy Criterion	Criterion Variable: Element Consistency F(1,1168)	Element Consistency p	Construct Stability F(1,1168)	Construct Stability p
Makhlouf-Norris bridging	0.69	.4072	1.51	.2198
Landfield--Smith and Leach functional similarity	7.60	.0059	33.66	<.0001

The fifth hypothesis predicted that the constructs meeting the Makhlouf-Norris criterion for superordinacy would have higher element consistency and construct stability than those constructs meeting the Landfield - Smith and Leach functional-similarity superordinacy

criterion. This hypothesis was not supported; in fact, the construct stability measures were significantly higher for the constructs meeting the functional-similarity criterion; $t(687) = 2.77$, $p = .0057$, and the element consistency scores showed no significant difference between the two types of constructs, $t(687) = 1.12$, $p = .2603$.

To summarize the initial analyses, a significant but very weak association was found between element consistency and the first-factor loading for each construct, and a stronger one between the first-factor loading and the stability coefficient. The Landfield - Smith and Leach superordinacy measure was successful in predicting both element consistency and construct stability, but the Makhlouf-Norris bridging superordinacy measure was not significantly associated with either criterion variable.

Supplemental Analyses

Because of the relatively weak association between the first-factor loading and element consistency, a supplemental analysis was performed to quantify the degree of association between the amount of total grid variance each construct accounted for and element consistency. This is a replication of Ryle's (1975)

study that provided a basis for the present hypothesis. A linear regression analysis comparing total variance with element consistency found that the degree of association between the two was somewhat stronger (r = .10481, p = .0003, vs. r =.06543, p = .0252 for the first factor alone).

To explore the relationship among the two measures of superordinacy derived from the first grid and other possible predictors of element consistency and construct stability, two stepwise regression analyses were performed. The first had element consistency as a dependent variable, and the second had construct stability. Both had the following independent variables for possible inclusion in the model; the Makhlouf-Norris bridging superordinacy measure, the Landfield--Smith and Leach functional-similarity measure, total grid variance accounted for by the construct, and a separate construct measure for each of the first seven principal components extracted from the grid, which quantified the grid variance explained by each factor for that construct. Significance levels for inclusion and retention in the model were set at p = .05.

Table 4. Results of Stepwise Regression Analysis with Element Consistency as a Dependent Variable and Superordinacy and Principal Components Measures as Independent Variables

Step	Variable Entered	Partial r**2	Beta weight	F	p
1	Factor 7	.0157	-.4041	18.62	.0001
2	Factor 5	.0154	-.1911	18.60	.0001
3	Factor 6	.0114	-.2258	10.16	.0015
4	Factor 2	.0041	.1391	6.20	.0249
5	Factor 1	.0061	.0927	6.63	.0061

Table 5. Results of Stepwise Regression Analysis with Construct Stability as a Dependent Variable and Superordinacy and Principal Components Measures as Independent Variables

Step	Variable Entered	Partial r**2	Beta weight	F	p
1	Factor 1	.0433	.1531	52.92	.0001
2	Factor 2	.0317	.1545	40.01	.0001
3	Factor 3	.0101	.0870	12.83	.0004
4	Factor 6	.0048	-.1863	6.20	.0129
5	Factor 5	.0052	-.2875	6.63	.0101
6	Factor 7	.0032	-.1888	4.19	.0408

The results of these stepwise regression analyses indicated that the best predictors for element consistency were not the superordinacy measures, but the loadings for individual principal components. The model included the first two principal-components loadings with positive beta weights, as well as the fifth through seventh principal-components loadings for each construct, all with negative beta weights. The two measures of superordinacy were not selected by the stepwise regression analysis for inclusion in the prediction equation.

Similar findings were obtained when the same set of variables were evaluated for their relation to construct stability. Selected variables were the first three principal-components loadings for each construct, all with positive beta weights, and the loadings for principal components five, six and seven, all with negative beta weights. Again, neither the bridging nor the functional-similarity superordinacy measures were sufficiently related to construct stability to be selected by the stepwise regression analysis.

CHAPTER 5
DISCUSSION

The purpose of this investigation has been to evaluate differing construct superordinacy measures by relating them to measures of construct change over time in a way that would determine how closely these superordinacy measures adhered to predictions made by Kelly in his theoretical work on construct systems. Having developed and tested hypotheses derived from a review of the pertinent construct theory literature, these findings will now be interpreted and the implications discussed. Also, limitations of the present study and measurement issues that may have a bearing on the results and their interpretation will be addressed along with suggestions for further research.

The concept of construct superordinacy as described by Kelly (1955) centered on a hierarchical ordering of constructs, with higher order constructs subsuming and organizing lower-level constructs. How this organization was expressed in repertory grids has been the subject of numerous studies, and several methods of measuring

superordinacy have been proposed. This study evaluated three different superordinacy measures by comparing them to two indices of construct system change.

First Factor Results

The first and second hypotheses operationalized superordinacy of a construct as its loading on the first factor derived from principal components analysis of the grid, and found positive associations between this first-factor loading and both criterion variables, element consistency and construct stability. Although the hypotheses were supported by the data analysis, the weak nature of the association made this measure practically useless as a predictor of element consistency and construct stability in individual grids.

This hypothesis was further support of work by Ryle (1975), who found a relationship between the amount of total grid variance explained by individual constructs and element consistency. Supplemental analyses using stepwise regression to determine the principal components measures most closely related to either criterion variable found that both element consistency and construct stability were highest in constructs that load positively on the first two or three principal components extracted from the grid, and load negatively on subsequently extracted components. Apparently element

consistency and construct stability are best predicted by a construct's property of having most of its variance aligned with that of other constructs.

This finding may be interpreted as other factor analytic results have been: the content of the grid is contained in the first two or three principal components, and the remaining components represent random error in construct usage. Assuming that element consistency and construct stability are appropriate criteria for the identification of superordinate constructs, Ryle's hypothesis that constructs accounting for more total grid variance would be superordinate has been refined by this finding. It appears that superordinate constructs are aligned with the major dimensions of the construct system variability, and have proportionally less error variance than subordinate constructs.

Functional-Similarity and Bridging Results

The functional-similarity measure is like the first factor measure in that its underlying assumption is that superordinate constructs would be those highly correlated with others in a construct cluster, and by extension in the rest of the grid. The results of tests of association between this measure and both element consistency and construct stability indicated that functional similarity to other constructs was a valid

predictor of a construct's stability of usage. Its superiority to the Makhlouf-Norris bridging measure of superordinacy in this study should be evaluated in terms of Kelly's theory.

In Hypotheses 4 and 5, the constructs that met the Makhlouf-Norris superordinacy criteria were hypothesized to be superordinate because of their property of connecting disparate clusters of constructs. This was based on the belief that constructs with this connecting property were more abstract, overarching concept that subsumed the constructs in the clusters that they connected. The results indicate that the constructs meeting the Makhlouf-Norris criterion did not demonstrate superior construct stability or element consistency characteristics. From the results of this study, it is possible to conclude that the more deterministic aspects of Kelly's theory are more important in construct system organization than the connections between clusters of constructs. Consequently, the design of this study must be evaluated for characteristics that might influence the comparison of these superordinacy measures.

Kelly's statements regarding the nature of superordinate constructs were the basis of the hypotheses that the bridging measure of superordinacy would relate to element consistency and construct stability, and would

prove superior to the functional similarity measure in this regard. He emphasized two aspects of the hierarchical structure of construct systems: the deterministic properties that superordinate constructs exercise over subordinate constructs, and the freedom of superordinate systems to reorganize the relations among constructs that are subordinate to them.

Kelly's writings support both sides of this dichotomy, stating that superordinate constructs

> are versions of those constructs that are subordinate to them. This makes the subordinate construct a form of reality which is construed through the use of the superordinate construct. (Kelly, 1955, p. 136)

This would support the Landfield--Smith and Leach view that superordinate constructs determine and are thus highly correlated with the constructs they subsume, but Kelly also supports the possibility that the relationship is not so deterministic, and that superordinate constructs differ from subordinate ones in this manner.

> A person's construction system is composed of complementary superordinate and subordinate relationships. The subordinate systems are determined by the superordinate systems into whose jurisdiction they have been placed. The superordinate systems, in turn, are free to invoke new arrangements among the systems which are subordinate to them. (p. 78)

Kelly did not see this as a contradiction, saying that freedom and determinism are meaningless except in terms of each other.

> Neither freedom nor determinism are absolutes. A thing is free with respect to something; it is determined with respect to something else. (p. 78, emphasis added)

> We described them (freedom and determinism) as essentially complementary aspects of the same hierarchical structure. That which is subsumed by a construct may be seen to be determined by it; that which subsumes the construct is free with respect to it. (p. 126)

Kelly emphasized the importance of the directionality of the relationship, a quality not directly assessable by the cluster and factor analytic techniques used in this study. One possible problem may be that this bridging property may not lend itself to correlational or cluster analytic techniques. The directionality of superordinacy relationships is not addressed by either factor or cluster analytic techniques, and new methodology such as conditional probability modeling or fuzzy set measures may be required to explicate relations of this nature (Bell, 1990). Fully confirmatory techniques such as path analysis are not suitable for identifying superordinate constructs in studies of this type, since this task is exploratory in nature.

Despite their common usage, factor and cluster analysis merely quantify associations among constructs, and do not determine which construct is influencing which when such an association is found. It would be reasonable to assume that the functional similarity measure would be less affected by this limitation than the bridging measure of superordinacy. Thus, it might fare better in direct comparisons with the bridging measure in studies using factor and cluster analytic techniques.

Hinkle's (1965) implications grid technique has been the only major method of assessing construct superordinacy that addresses this directionality issue, and in the light of these findings it is possible to re-interpret the failure of his measure to correlate with factor analytically derived superordinacy measures. It may be that factor analysis, cluster analysis and other similar techniques will produce results different from his implication grid method not because of any difference between indirect and self-report measures, but because these correlational measures are successful at explicating similarities in vertical structure, while Hinkle's measure is sensitive to the horizontal structure of linkages between construct clusters.

Another explanation for the obtained results is that the criterion variables selected may not adequately describe the properties of superordinate constructs, instead favoring constructs that meet the functional similarity criterion. Despite efforts to develop measures that quantify the dimensionality of change, the two used in this study remain susceptible to criticism that they do not measure the property of stability within change that Kelly found essential to understanding the dynamic nature of construct systems. Stability measures measure the absence of change, not change itself. Since the first factor and functional similarity superordinacy measures quantify the degree of association in the construct's relation to the rest of the construct system, there may be a bias in the measurement process.

This may be partially explained by properties inherent in any form of psychometric measurement; a large cluster of highly intercorrelated constructs in a grid will determine the direction of the first principal component, and thus load heavily on that component. At the same time, ratings on these constructs will tend to be more consistent and reliable due to their close intercorrelation; each construct serves as a reference for the others in the cluster, and a subject completing the grid will use constructs in this cluster in a more

stable and reliable manner. The design of the present study does not allow for differentiating between superordinacy and other reasons why some constructs may be more stable in their usage than others. The development of psychometrically sound methods for measuring this aspect of construct system reorganization may be required before the Hinkle and Makhlouf-Norris methods can be demonstrated to select constructs with the hypothesized properties of linking clusters of subordinate constructs.

Another issue pertinent to the results obtained in this study and their interpretation is the question of instrument suitability. Because of limitations on grid size due to subject fatigue and the limited ability to elicit large numbers of unique constructs, the data base for explicating construct relationships is necessarily small. The organizing properties of superordinate constructs that connect clusters of constructs may not be assessable through analyzing grids of this size. Kelly's theory applies to construct systems, not repertory grids, and the failure to discern these organizing properties may be an artifact of the limitations that this measurement process imposes on research in this area.

A re-examination of some of the grid design decisions that may have had a bearing on the outcome of this study must address the issue of elicited versus supplied constructs. Although care was taken to provide a representative sample of constructs, the use of supplied constructs may have had an unanticipated effect on the outcome of this study. Hinkle's method elicited constructs by asking why one pole was preferred over the other, and the constructs elicited in this manner may differ from the ones used in this study.

A final measurement issue is the suitability of the time interval between administrations. Construct system reorganization is a gradual and cumulative process compared to measurement error, which is constant and independent of the length of time between tests. Therefore, longer test-retest intervals would be more likely to have a larger proportion of the change between administrations reflect actual construct system reorganization rather than random variation. A short interval was chosen, among other reasons, because it was believed that subordinate constructs change more rapidly than superordinate ones, so allowing an unnecessarily long interval would decrease the differential change between the two types of constructs. However, in retrospect, it may be that the time interval was too

short to allow sufficient construct system change to occur, and the properties measured were more affected by the subjects' familiarity with the construct label than its superordinacy in their construct system.

Conclusions

It would be premature to conclude that the issue of correct assessment of superordinacy has been resolved as a result of this study. Several measurement issues have been raised that will need to be addressed before a definitive answer to this question will be forthcoming, but this study has clarified the role that the nature of the criterion variables play in the evaluation of superordinacy. Current methodology is more proficient at measuring the absence of change than the pattern of it, and this bias predisposes studies of this type to find functional similarity measures to be better predictors of superordinacy than bridging measures. Kelly's original objections to traditional psychometric approaches still hold; the properties that he predicted for construct systems are difficult to demonstrate within the context of measurement theory. However, directions for future research on this topic have been clarified. Use of analysis that will take into account the directional,

non-reciprocal aspects of the relation between superordinate and subordinate constructs such as conditional probability models may provide the necessary methodology to explicate the horizontal linkages among constructs, just as correlational techniques are useful for demonstrating vertical linkages within the construct system. Finally, future research may resolve the dichotomy between Hinkle's and Makhlouf-Norris' approach and the remainder of construct theory research by finding that these seemingly disparate measures are complementary aspects, horizontal and vertical, of the same construct system structure.

APPENDIX A
GRID INSTRUCTIONS

You have been given this set of instructions, a GRID FORM, which is a piece of paper with flip-up "leaves" stapled to it, and a ROLE LIST.

STEP ONE: Naming the Roles

Start wth the ROLE LIST. Beginning with your own name, write the first names of the persons described. This name is for your understanding only, so nicknames, initials, etc. are fine as long as you write down something about the person that will clearly bring to mind that person's identity. You do not have to give an exact, literal interpretation to the descriptions; note that stepfathers will substitute for fathers. What we're asking for is the name of the person who served as a father figure to you, whether or not he is your biological father. The same goes for the brother and sister roles. Not all of us had siblings, but virtually all of us had someone whom we thought of in that context, who filled that role. Be sure to use eleven different names; none of the blanks should have the same person's name on them. Once you have a different name on each of the 11 blanks, transfer the names to the 11 "leaves" which are the flip-up pieces of paper attached to the center of the GRID FORM. Number each leaf, 1 through 11, and write the corresponding name at the bottom of the leaf.

STEP TWO: Rating the People (GRID FORM)

Start with the top leaf with your name on it. Now look at the word outgoing on the left side of the grid and also at the word shy on the right side of the grid. Use the numbers in the middle (printed on the flip-up leaves) to rate yourself in relation to each pair of words. For example, what you'll see on the form looks like this:

Outgoing 6 5 4 3 2 1 0 1 2 3 4 5 6 Shy

If you see yourself as shading toward the outgoing side, then circle the 1 or maybe the 2 on the left (outgoing) side. However, if you see yourself to be very outgoing, you would circle the 5 on the same side. Use the modifying words at the top of the grid form for guidance. If you think of yourself as shy, you would use one of the numbers on the right side. Use the zero in the middle only if you can't apply the words at all, or if they apply equally.

Next, look at the following pair of words, and think about which word applies to you and how it applies to you. Circle the appropriate number. Do this for the remaining 13 pairs of words down the sides of the grid form, and then fold the first leaf up. The second leaf underneath it has your mother's name on it. Rate her 15 times the same way you rated yourself, and then go on through the remaining people listed on the other leaves.

STEP THREE: Indicating the Preferred Pole

The final task needed to complete the grid form is looking back at each pair of words or phrases and putting a check mark beside the one on each pair that you prefer, the one that seems more favorable to you. For instance, if you think that, in general, it's better to be outgoing than to be shy, you would put a check mark in the margin to the left, next to the word outgoing. Do this for the remaining 14 pairs, and you will be through with this administration of the grid.

WHEN YOU HAVE FINISHED LET THE EXPERIMENTER KNOW.
After he or she has checked your grid for completeness, you will be asked to put your Role List in the envelope provided. You will need to place your name on the outside of the envelope and seal it in the experimenter's presence. After a subject number has been assigned to your grid you may erase or mark out the names provided in the leaves, if you so choose. After you have completed the second administration in four weeks, you may keep the Role List with the names on it. The experimenter is interested only in what you write on the rating grid. A number will be assigned to both of your grids instead of your name to ensure anonymity.

PLEASE DO NOT LEAVE UNTIL THE EXPERIMENTER HAS CHECKED WITH YOU PERSONALLY AND GIVEN YOU PERMISSION.

Thank you for your participation.

APPENDIX B
ROLE LIST

1._____ Write your own name.

2._____ Write your mother's name. If you grew up with a stepmother, write her name instead.

3._____ Write your father's name. If you grew up with a stepfather, write his name instead.

4._____ Write the name of your brother who is nearest your own age. If you have no brother, write the name of a boy near your own age who was most like a brother to you during your early teens.

5._____ Write the name of your sister who is nearest your own age. If you have no sister, write the name of a girl near your own age who was most like a sister to you during your early teens.

6._____ Write the name of your wife (or husband) or, if you are not married, your closest present girl(boy) friend/lover.

7._____ Write the name of your closest girl(boy) friend/lover immediately preceding the person mentioned above.

8._____ Write the name of your closest present friend/pal.

9._____ Write the name of a person whom you once thought of as a friend/pal, but in whom you were badly disappointed later.

10._____ Write the name of a teacher/professor that you particularly liked.

11._____ Write the name of a teacher/professor that you particularly disliked.

APPENDIX C
GRID FORM

Rating Scale

	6	5	4	3	2	1	0	1	2	3	4	5	6	
	Totally Very		Usually	Somewhat		Slightly			Slightly	Somewhat	Usually	Very	Totally	
Outgoing	6	5	4	3	2	1	0	1	2	3	4	5	6	Shy
Adjusted	6	5	4	3	2	1	0	1	2	3	4	5	6	Maladjusted
Dependent	6	5	4	3	2	1	0	1	2	3	4	5	6	Independent
Organized	6	5	4	3	2	1	0	1	2	3	4	5	6	Spontaneous
Immature	6	5	4	3	2	1	0	1	2	3	4	5	6	Mature
Flexible	6	5	4	3	2	1	0	1	2	3	4	5	6	Structured
Reserved	6	5	4	3	2	1	0	1	2	3	4	5	6	Emotional
Inconsiderate	6	5	4	3	2	1	0	1	2	3	4	5	6	Considerate
Predictable	6	5	4	3	2	1	0	1	2	3	4	5	6	Impulsive
Team-leader	6	5	4	3	2	1	0	1	2	3	4	5	6	Team-worker
Aloof	6	5	4	3	2	1	0	1	2	3	4	5	6	Friendly
Calm	6	5	4	3	2	1	0	1	2	3	4	5	6	Energetic
Responsible	6	5	4	3	2	1	0	1	2	3	4	5	6	Irresponsible
Boring	6	5	4	3	2	1	0	1	2	3	4	5	6	Interesting
Serious	6	5	4	3	2	1	0	1	2	3	4	5	6	Carefree

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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